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FOR

METHOD AND SYSTEM FOR PERFORMING AND DELIVERING ANALYSIS OF SPORTS ACTIVITIES

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TITLE OF THE INVENTION

METHOD AND SYSTEM FOR PERFORMING AND DELIVERING ANALYSIS OF

SPORTS ACTIVITIES

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BACKGROUND OF THE INVENTION

1.   Field of the Invention

The present invention relates to methods and systems for recording progression of sports

activities and delivering analysis information of such events to participants and spectators of the

15   event, or other interested parties.

2.   Discussion of the Related Art

Participants in a sports activity usually strive to improve their performance in a game. In

order to improve performance, it is necessary to analyze the activity beyond the scores kept as

20   part of the activity. Such analysis may contain statistical information about individual

movements in the game, interesting patterns of movement, strategies, and improvement

recommendations. Similarly, spectators of sports activities often desire to gain insights into the

observed activity as well.

There are several existing products on the market primarily targeting professional tennis instructors that provide the ability to analyze tennis games. Also, there are systems that are used during broadcasts of tennis matches on television to create match statistical analysis.

Existing products for analyzing progression of sports activities are generally divided into

5   three categories: (1) software products running on a computer; (2) software products running on a personal digital assistant (PDA) device; and (3) specialized electronic hardware products the size of a PDA.

Computer-based programs require a fairly bulky computer or a relatively expensive Pocket PC-type device to be brought to the game. PDA-based programs may utilize a touch

10   sensitive screen to enter data, which requires the observer to take his/her eyes away from the game to enter the data. For a fast-moving game, this mode of input may lead to missing portions of a game.

All such products usually require a prior purchase of a specialized appliance, or a software program that requires a computer, PDA, or specialized electronic device present for

15   such recording. Such purchases limit applicability of the existing products only to the top players or tennis professionals that can amortize the cost of such a purchase over a series of matches.

Existing systems at best allow comparisons to statistical averages based on the match information entered via a specially purchased system. These systems do not have access to the

20   data entered via other units.

Also, none of the existing systems can be used by a participant of a match. All of them require a third-party observer to enter the information into the system.

And finally, in existing systems, the statistical information is available in real time only to the person performing the data entry. There are no easy means of delivering such information to the spectators.

Accordingly, it is desirable to provide methods and systems for recording and delivery of

5   sports activity analysis by imposing as little as possible of a burden on the user.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a block diagram of process components involved in delivery of game analysis services according to an embodiment of the present invention;

10   Fig. 2 illustrates sample standard telephone keypad key encodings for a singles tennis match according to an embodiment of the present invention;

Fig. 3 illustrates sample tennis singles match grammar utilized to generate input parser according to an embodiment of the present invention;

Fig. 4 provides sample terminal token definitions for a voice input mode of recording for

15   use in conjunction with tennis match grammar according to an embodiment of the present invention;

Fig. 5 illustrates sample terminal token definitions for a telephone keypad input mode of recording for use in conjunction with tennis match grammar according to an embodiment of the present invention;

20   Fig. 6 illustrates a sample match high-level information report according to an embodiment of the present invention;

Fig. 7 illustrates a sample graphical representation of a foreground stroke analysis report for a left-handed player according to an embodiment of the present invention;

Fig. 8 illustrates a sample database schema for storing stroke and point information according to an embodiment of the present invention; and

Fig. 9 illustrates a sample of voice notation for recording singles tennis matches according to an embodiment of the present invention.

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DETAILED DESCRIPTION

According to an embodiment of the present invention, a person observing a game enters a game progression via a telephone device, such as a cellular telephone or a landline (wired or cordless) telephone. The game may be observed live, or from a previously recorded media.

10   Fig. 1 provides a block diagram of process components involved in delivery of game analysis services according to an embodiment of the present invention. According to one embodiment of the present invention, an observer calls a telephone number to establish a connection with an input interpretation module **105** of the system. The observer provides information about the match and players into the input interpretation module **105** via, for

15   example, menu driven interactions using voice and/or keypad entries, utilizing, for example, dual tone multi-frequency (DTMF) signals, or any other suitable signal types. Some examples of tennis match information may include: indoor/outdoor venue, type of surface, lighting, wind conditions, match format, etc.; and the players' information may include: names, IDs, gender, left or right handed, skill level, etc. The game progression may be entered using standard

20   telephone keypad keys or via voice commands using a telephone **100**. For example, one may speak the following sequence of utterances for a play: "player 1, serve, down the line, let, serve, cross court, error long, serve, center, forehand ground, backhand volley, lob, winner, score 30

15, etc." Alternatively, one may enter a sequence of keypad entries that correspond to the above

utterances (described further below).

Fig. 9 illustrates a sample of voice notation for recording singles tennis matches

according to an embodiment of the present invention. Table **910** provides sample recognized

5   voice utterances for describing serve strokes. Table **920** provides sample voice encoding for all

other strokes. Table **930** provides sample segments concluding entries, and table **940** provides

encoding for entering score entries.

Fig. 2 illustrates sample telephone keypad key encodings for a singles tennis match

according to an embodiment of the present invention. Table **200** provides encoding for stroke

10   types; table **210** provides encoding for stroke placement; table **220** provides encoding for stroke

errors; table **230** provides encoding for stroke trajectories; table **240** provides encoding for a

stroke winner; table **250** provides encoding for various corrections; table **260** provides

miscellaneous entries, such as indicating player locations on the court, missing parts of

recording, etc.; and table **270** provides encoding for point, game, set and match concluding

15   entries. For example, the following is a telephone keypad key sequence for encoding the above

mentioned game sequence "left, serve, down the line, let, serve, cross court, error long, serve,

center, forehand ground, backhand volley, lob, winner, score 30 15" utilizing the tables of Fig. 2:

"44 8 15551 44 2 080 44 5 3 * 55 **** 30 15", where the spaces are shown here for readability.

In one mode of operation according to an embodiment of the present invention, a third

20   party observing a game may enter a game progression either using keypad entries or voice. In

another mode of operation according to an embodiment of the present invention, a player

participating in a game may, for example, enter a game progression utilizing a cell phone with a

headset during matches. This mode of operation may allow a teaching professional, for example, to enter a game progression, or progression of a training session with a student.

Information may be recorded for just one player or all players in a match. One may record just the opening and concluding shots of every point, or choose to record every single shot

5   played. Also, depending on the speed of the game and the number of players being recorded, additional information may be provided. For example, stroke placement and trajectory, as well as stroke spin and power characteristics may be entered. If information about opponents is entered, it enables more detailed analysis about strategies. Additional information about stroke placement enables more detailed analysis of strokes for a player. The method also allows for the

10   score information to be entered for each point, game, set and match.

Referring back to Fig. 1, the input interpretation module **105** interprets telephone input data and saves it into a raw game recording database **110**. An input parsing module **115** extracts data from the raw game recording database **110**. The input parsing module **115** may utilize match grammar, a sample of which that may be implemented is illustrated in Fig. 3. However,

15   any other suitable match grammar may also be utilized.

Referring to Fig. 3, tennis match definitions start at block **300**. The tennis match is defined as a Point with Completions **302** repeated one or more times and followed by a Match Over **303**. Point with Completions **302** is defined as a Point **304**, optionally followed by a Shot Winner **306**, followed by a Point Over **308**, and then optionally followed by an After End of

20   Point **310**. An After End of Point **310** is defined as optional Game Score Entry **312**, optionally followed by a Point Played Over **314**, optionally followed by a Game Over **316**, and finally optionally followed by a Set Over **318**. Point **304** is defined as a Serve Sequence **322**, optionally followed by Shots **324**. A Shot **324** is defined as a Right Player Stroke **326** or a Left Player

Stroke **328**, optionally followed by Stroke Properties **330**. Stroke Properties **330** are defined as a sequence **332** of Stroke Error **334**, a Stroke Trajectory **336**, and a Stroke Placement **338** provided in arbitrary order. Serve Sequence **322** is defined as a Right Player Serve Sequence **340** or a Left Player Serve Sequence **342**. Left Player Serve Sequence **342** is defined as Left Player Single

5 Serve Let Sequence **348**, optionally followed by block **350**. Block **350** is defined as optional Stroke Placement **338** with mandatory Stroke Error **334** provided in arbitrary order, followed by a Left Player Single Serve Let Sequence **348**, optionally followed by Stroke Error **334** and Stroke Placement **338** provided in arbitrary order. Stroke Error **334** is defined as an Error Type **344**, optionally followed by a Forced Error **346**. Left Player Single Serve Let Sequence **348** is

10 defined as a Left Player Serve **352**, optionally followed by a Stroke Placement **338**, optionally followed by a sequence **354** consisting of Let **356** and recursively Left Player Single Serve Let Sequence **348**. Right Player Serve Sequence may be defined in a similar fashion. A sample of the textual form of the grammar is provided below as Table A. Accordingly to one embodiment of the present invention, Fig. 3 formally defines all of the possible legal sequences of tennis

15 match descriptions in terms that are familiar to a tennis player as described in Fig. 9. However, in alternative embodiments of the present invention, other possible legal sequences of tennis matches, or other events, may be implemented. For example, it is possible to define training session sequences that correspond to specific practice drills.

TABLE A: TENNIS MATCH PARTIAL GRAMMAR

startrule : PointWithCompletion(s) MatchOver

startrule : PointWithCompletion(s) MatchOver

PointWithCompletion :
 Point ShotWinner(?) PointOver AfterEndOfPoint

AfterEndOfPoint :
  (GameScoreEntry(?) PointPlayedOver(?))
  GameOver(?) SetOver(?)

Point :
 ServeSequence Shot(s?)

Shot :
(RPlayerStroke | LPlayerStroke) StrokeProperties(?)

StrokeProperties :
  (StrokeError((StrokePlacement(?)
                        StrokeTrajectory(?))
| (StrokeTrajectory(?) StrokePlacement(?))))
| (StrokePlacement ((StrokeTrajectory(?)
                        StrokeError(?))
| (StrokeError(?) StrokeTrajectory(?))))
| (StrokeTrajectory (
        (StrokeError(?) StrokePlacement(?))
| (StrokePlacement(?) StrokeError(?))))

StrokeError :
 (ErrorType ForcedError(?))

StrokePlacementAndTrajectory :
  (StrokePlacement(?) StrokeTrajectory(?))
| (StrokeTrajectory(?) StrokePlacement(?))

StrokePlacementWithError :
 (StrokeError StrokePlacement(?))
| (StrokePlacement StrokeError)

StrokePlacementAndError :
 (StrokeError(?) StrokePlacement(?))
| (StrokePlacement(?) StrokeError(?))

StrokePropertiesWithError :
 (StrokeError StrokePlacementAndTrajectory)
| (StrokeTrajectory(?) StrokeError StrokePlacement(?))
| (StrokePlacement(?) StrokeError StrokeTrajectory(?))
| (StrokePlacementAndTrajectory StrokeError)

ServeSequence :
 LPlayerServeSequence | RPlayerServeSequence

LPlayerServeSequence :
 LPlayerSingleServeLetSequence['1']
 (StrokePlacementWithError
   LPlayerSingleServeLetSequence['2']
 StrokePlacementAndError(?))(?)

LPlayerSingleServeLetSequence (serveN):
 LPlayerServe[$serveN] StrokePlacement(?)
 (Let LPlayerSingleServeLetSequence[serveN])(?))

RPlayerServeSequence : #like LPlayerSequence

GameScoreEntry :
 (RegularGameScoreEntry | TieBreakScoreEntry)
  EndOfScoreEntry

The match grammar, in conjunction with the definition of the terminal symbols, is

utilized to automatically generate a program for input parsing. Fig. 4 provides sample terminal

5   token definitions for a voice input mode of recording for use in conjunction with tennis match

grammar according to an embodiment of the present invention, and Fig. 5 illustrates sample

terminal token definitions for a telephone keypad input mode of recording for use in conjunction

with tennis match grammar according to an embodiment of the present invention. With the help

of an error correction module **120** (see Fig. 1), the input parsing module **115** produces detailed

game transaction records logged into a game transactions database **125** registering entered

information about every stroke and point in the game. For example, the system may keep the

following information for every stroke-player reference: stroke type, forehand or backhand,

5   stroke placement, trajectory, was it a let, was it a winner or error shot, if error, was it a forced

error, etc.

Fig. 8 illustrates a sample database schema for storing stroke and point information

according to an embodiment of the present invention. Sample table schemas for PointInfo **810**

and for StrokeInfo **820** tables list field names, field types and attributes, values for enumerated

10   fields, primary keys, and default values for the fields. For example, the StrokeInfo **820** table

composite primary key consists of a RecID (record identification) field and StrokeInMatch

(stroke number in the match) field. For the StrokePlacement field, it lists legal enumerated

values as "CrossCourt", "Middle", "DownTheLine" and "InsideOut". The StrokeInfo **820** table

further indicates that NULL value is allowed for this field and NULL is the default value, if no

15   explicit value is given.

The input processing mechanism may be designed to be forgiving of input errors. For a

fast paced match, there is frequently no time to request correction of data entry errors in real time

from a user. The system attempts to recover from the input mistakes whenever possible and

when it is not possible, the transactional entries are marked as erroneous. For example, the

20   system may allow a user to enter erroneously a serve from the wrong side of the court,

processing the rest of the input sequence to maintain the game's pace. The system may attempt

to fix the error automatically, for example, if it can be determined contextually, based on the

subsequent input, that the serve in the correct progression of the game would have to have been

performed from the other side.

Referring back to Fig. 1, a statistical analysis module **130** produces detailed game

statistics and stores it into a games statistics database **135** using information from the game

5   transactions database **125**. Fig. 6 illustrates a sample match high-level information report

according to an embodiment of the present invention. Table **610** provides player names and

indicates the winner. Table **620** provides match and recording type information. Table **630**

provides match score by set. Table **640** provides summary match statistics. Table **650** provides

a breakdown of winners versus errors report by stroke type. The system may calculate hundreds

10   of statistical values about every aspect of the game, such as scoring characterization, player

performance characterization, team performance characterization, temporal-based performance

characterization, location-based performance characterization, and objects of the game-based

performance characterization. Other statistical values and aspects of the game not mentioned

above may also be calculated.

15   For example, for every player, the system may calculate percent of first serves in from

deuce side, number of aces serving wide from ad side, number of winner and errors, return of

serve consistency from the backhand side, points won when the first serve was in, etc. Fig. 7

illustrates a sample graphical representation of a foreground stroke analysis report for a left-

handed player according to an embodiment of the present invention. The report **700** illustrates

20   that there were nine errors versus one winner for this stroke. Additionally, 50% of strokes were

hit cross court, 30% in the center, and 20% were placed down the line. The only winning shot

was hit cross court. The report **700** further provides the breakdown of errors by stroke

placement, indicating that there was one error into the net for each of the cross-court and center

placed shots. There were two errors wide, five errors into the net for down the line placed

forehand ground strokes.

Referring back to Fig. 1, an update group of players' averages module **140** updates a

group of players' averages (or team averages) and stores it into a group of players' averages

5   database **145** using information from the games statistics database **135**.

A patterns detection module **150** detects repeated patterns of player behavior. Patterns of

behavior are defined as statistically significant events or comparisons. Patterns may be defined

as triggering events. The level of significance may be set individually for each pattern. Patterns

involve comparisons of statistical analysis values derived by the statistical analysis module **130**

10   (game analysis records), as well as direct analysis of game transaction record from the game

transactions database **125**. Patterns involve temporal and location-based characterization of

players, teams, and objects of the game. For example, Player 1 comes to the net immediately

after the serve; Player 2 hits at least two shots cross-court from the forehand side before hitting

down the line.

15   An improvement recommendations module **165** provides recommendations for

improvement. For example, "Player 1's current first serve percentage is 90%. Player 1 can

safely increase the speed of the first serve bringing the first serve percentage to the 70%-80%

range, providing a better chance of winning serve points." Here are two more examples: "Player

2's backhand volley consistency was 35%. Player 2 needs to work on improving the backhand

20   volleys." "Most players at the next level of proficiency have a 'weapon' shot leading to a high

percentage of winning shots. Player needs to work on developing such a weapon stroke."

A strategy recommendation module **160** provides strategy recommendations for playing

against a specific opponent. For example, "long rallies you win 75% of the time — do not over

hit, just stay in the rallies. 90% of the serves of your opponent from the deuce court are to your forehand. None of the serves to your backhand were aces or return errors. You may want to move just a bit more to your forehand side while receiving the serve."

A comparisons with group averages module **155** provides comparison of your statistics
5   (or of another player) against average statistics of a group of players (or team averages). For example, "your backhand ground stroke consistency is well below the average consistency of players at your level", or "your volley consistency is well above the average consistency of the players at your level."

Information from the game statistics module **135**, pattern detection module **150**,
10   comparisons with group averages module **155**, strategies recommendations module **160**, and improvement recommendations module **165** is deposited into a matches analysis repository **170**. Devices providing telephone **190**, Web browser **193**, and textual transmissions **196** capabilities may send requests for various match information pieces to a request for information processing module **180**. For example, one could request a short or expanded statistical report, report by sets,
15   just serve statistics, comparison to averages report, strategy recommendations, etc. The request for information processing module **180** collects information from the matches analysis repository **170** and directs a speech generation module **175** or a text and/or graphics generation module **185** to generate the appropriate response to the requesting module **190**, **193** or **196** rendering of the information in voice, graphics, animation, and/or textual form, passing the information to devices
20   supporting voice **190** and/or text and/or graphics **193** or **196** capabilities such as e-mail, Web page reports, pagers, short message service (SMS), fax, instant messaging, etc.

A Web browser **193** may reside on any device such as a computer or even on a cell phone equipped with Web browsing capabilities. Similarly, e-mail, paging, SMS, instant messaging,

fax, or any other suitable data transmissions may be delivered to any device supporting such service(s), even through the same cellular telephone that was utilized for data entry of a game progression. Information may be delivered using "push" or "pull" technology. Delivery may be performed during a match, updating information after every set, or when some statistically

5   significant changes in the running averages occur.

A user of the telephone input **100** may issue a command to record unparsed voice utterances that are captured by the input interpretation module **105** and stored in the raw game recording database **110**. Such unparsed voice utterances may represent comments, insights, or recommendations, and are keyed by the segment of the game when they are made. Recorded

10   comments may be related to the individual strokes or point progression, or may represent comments on the overall game. For example, an observer may provide information regarding the depth of a stroke or strokes, change in the movement pattern of a player, information regarding position of a player on court, recommendations on shot selection, comments regarding demeanor on court, appearance of signs of player injury, change in weather conditions, etc. Recorded

15   comments may represent observations about the game or training session that are not captured via the parsed recording format. These comments may be made available for review via devices that support playback, for example, such as a telephone **190** and a Web browser **193**.

Telephone input **100** may be provided by the same device as the telephone **190** for receiving data, as discussed above. Alternatively, the telephone input **100** may be provided by a

20   different device and person as well. Also, there may be multiple telephone devices **190**, Web browser devices **193**, and text/graphics devices **196** receiving information simultaneously. This mode of operation enables many spectators watching a match to access match statistics and match analysis information all at the same time.

Accordingly to one alternative embodiment of the present invention, the telephone input **100** may be provided via a digital mode of telephone connectivity, such as via a Web browser, SMS, email, I-mode (NTT DoCoMo mobile Internet access system), wireless application protocol (WAP), or via instant messaging. Telephone input **100** may be performed using special

5   keys and buttons on a phone, such as a navigation joystick, up-and-down navigation keys, an alpha-(numeric) keypad, a touch-sensitive screen, etc. Telephone input **100** may be provided in a mixed mode of communication using voice and telephone keys (or other manual input) as well. The system may allow for a user of the telephone input **100** to select a language to be used for data entry, when appropriate. The voice recognition may be performed by speaker-independent

10   or speaker-dependent speech recognition engines. Also, a speaker may pre-record custom utterances that may be utilized by the recognition engine.

According to yet another embodiment of the present invention, for telephones equipped with programming capabilities, (e.g., Java 2 Platform Enterprise Edition (J2EE) capable phones), the input interpretation module **105** for processing keypad and text entries may be carried out via

15   a custom program residing on the telephone. In a case where the telephone has capabilities for speech recognition and programming capabilities, the input interpretation module **105** for processing voice entries may be carried out by the telephone as well. Similarly, any portion of the further processing steps (*see* Fig. 1) from the raw game recording storage **110** to the text and graphics generation **185** may be carried out on a telephone capable of carrying out such

20   computations or on a similarly-equipped device.

The described analysis capabilities may be performed on any off-the-shelf device (e.g., mobile phones, PDAs, laptops, etc.), either "dumb" or "smart", distributing the described processing between the device and the back-end system to achieve the most economical solution

to the user, taking into account the costs of custom program development, communication costs, and the costs of performing back-end processing. The notion of the most economical solution will change over time as penetration of "smart" phones and devices increases, and communication costs of voice and data connections change.

5   According to one embodiment of the present invention, the telephone input **100** may encompass the input interpretation module **105**, the input parsing module **115**, and the error correction module **120** capabilities on the phone or on a similarly-equipped device itself. It may be also possible to provide some of the "further down the line" processing functions (*see* Fig. 1) on the telephone device. In one specific embodiment of the present invention, all processing

10   functions may be carried out on the communication device itself. Match recording and analysis may be performed without establishing connectivity with a back-end system. At some later point in time, such device may connect to a remote system to store the recorded games and data, to obtain updates of statistical averages, to obtain patterns extracted from the analysis of a larger set of recorded matches, and to update strategy recommendation rules or other customization

15   information.

As discussed above, it may also be possible to utilize an alternative communication device instead of a telephone, such as an e-mailer (e.g., a Blackberry), paging device, or any other device enabling transmission/connectivity capabilities.

Targeted advertisements may also be delivered to the device utilized for entering or

20   receiving the information as part of providing the service.

The same methodology may apply for the construction of systems allowing spectators to access game statistics and analysis information.

According to another embodiment of the present invention, multiple players or observers of an event may enter game progression simultaneously for a partial game progression as it relates to the actions of only some of the players. Partial game progressions may allow users to enter more detailed information about the game, and the complete game action is reconstructed

5 by combining time stamped inputs from multiple recording streams. For example, each player in a doubles match may record their own strokes using separate input devices utilizing voice input; or two observers may enter information only for one of the opposing teams.

According to another embodiment of the present invention, tabulation of game statistics may be performed directly without creating database entries for individual stroke entries.

10 According to yet another embodiment of the present invention, multiple spectators of an event may enter game progression simultaneously, potentially competing for a prize. Data entries may be judged based on the accuracy and completeness of the recordings. This mode of operation allows obtaining higher fidelity game depictions based on the averages of the inputs.

In yet another embodiment of the present invention, voice input describing a match may

15 be stored in the input device and then transferred to the back-end system for processing. Such transfer may be performed manually at the end of a match by taking, for example, a removable media and moving it to the processing system in a digital (e.g., memory card, etc.) or an analog form (e.g., tape). Furthermore, digitally stored recordings may be transferred to the back-end system at some later point in time via, for example, a digital communication connection.

20 Alternatively, voice input also may be digitized and streamed to the back-end system as data without storing it on the input device.

Similar methodologies may apply to the construction of systems for the analysis of other sports activities, and is thus not limited to that of only tennis. Additionally, observations of other

events, including other sports and non-sporting events, may also be recorded utilizing

embodiments of the present invention.

Accordingly to embodiments of the present invention, analysis of sports activities, for

example, may be delivered without the need for additional software purchases or downloads, or

5   specialized hardware purchases by the end user. The service is available for anybody with

access to a standard telephone, and most conveniently any wireless telephone, such as a cellular

phone, without imposing any additional equipment requirements. The players themselves are

provided the ability to enter the game progression in real-time, while playing a game. A tennis

coach may enter the game progression or training session progression while playing or feeding

10   the ball to a student player. Additionally, there is no need to look away from the observed game

to enter game information when voice input is used, or the game progression may be entered

utilizing the familiar telephone keypad keys layout, not requiring taking one's eyes away from

the game to enter the game information. A player or a tennis coach may receive match statistics

and recommendations in real-time during friendly matches or coaching sessions, via a headset

15   connected to a telephone via a wire or wirelessly. Player (and/or team) statistics may be

compared to the averages of a group of players (team) at an equivalent skill level of play.

Embodiments of the present invention may also provide the ability to deliver recommendations

for player improvement based on the comparison with the averages of players at the same or

higher skill level. An observer, a player or a coach may record comments, insights, or

20   recommendations during the match recording. Recorded voice segments are made available for

playback during the review via telephone, Web site, or any other means of access that support

audio. Spectators may have the ability to receive match statistics while watching a match via a

telephone or other device supporting Web browsing, e-mail, SMS, or other means of transmitting

information. And, embodiments of the present invention provide an infrastructure for delivering continuously improving custom recommendations for the players without the need for software or hardware upgrades at the user end.

5   While the description above refers to particular embodiments of the present invention, it will be understood that many modifications may be made without departing from the spirit thereof. The accompanying claims are intended to cover such modifications as would fall within the true scope and spirit of the present invention. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, rather than the foregoing description, and all

10   changes that come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.